3Com® Corporation

PathBuilder™ S200 Series Switch
Voice Over IP

Notice

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Overview

Introduction

This document describes the Voice Over IP (VoIP) feature for 3Com's PathBuilder S200 series switch Products.

Note

Parameters and applications for voice traffic are discussed in the manual. For information on SoTCP and serial data applications, refer to the IP and LAN Feature Protocol documentation.

In This Manual

Topic	See Page
About Voice over IP (VoIP)	2
Network Topology	3
SoTCP Operation	4
Establishing a Call	5
VoIP Applications	8
Example VoIP Configuration	9
Configuring VoIP	11
SoTCP Parameters	12
Route Selection Table Parameters	15
SoTCP Map Table Parameters	16
Statistics	18
SoTCP Statistics	19
SoTCP Detailed Statistics	20

Glossary of Terms

These terms appear throughout this document:

- ACP - Adjacent Channel Protocol
- VoIP - Voice over IP
- SVC - Switched Virtual Circuit
- UDP - User Datagram Protocol
- SoTCP - Serial Protocol Over TCP

About Voice over IP (VoIP)

What is VoIP?

PathBuilder S200 series switch products support Voice over IP (VoIP) to provide termination and encapsulation of voice and fax traffic for transport over an IP network (see to Figure 1). 3Com's proprietary protocol, Serial Protocol over TCP (SoTCP), provides the encapsulation mechanism for carrying voice traffic over an IP network.

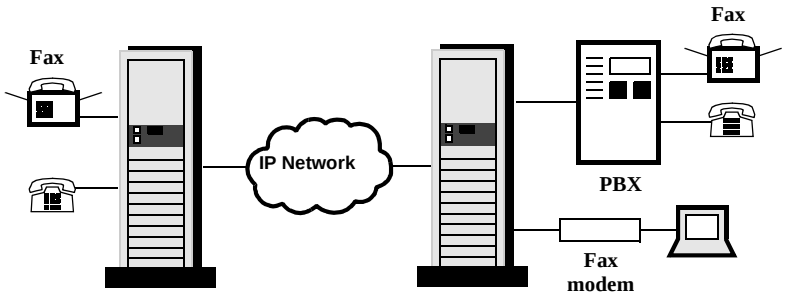

Figure 1. Voice over IP Network

VoIP Applications

VoIP provides new and cost effective solutions for a company's telephony communication including:

- Long distance calling over an Intranet or the Internet
- Remote location dial-in and telecommuting

Features

Key features include:

- real-time voice and fax over IP networks
- multiple SVCs over a single UDP session
- call management and signalling using TCP

Product Support

These PathBuilder S200 series switches support VoIP:

- PathBuilder S21x switch
- PathBuilder S24x, 26x, and 27x switch

Network Topology

Introduction

This section describes a typical network topology for the application of VoIP.

Network Topology

Figure 2 illustrates a typical network topology for voice traffic.

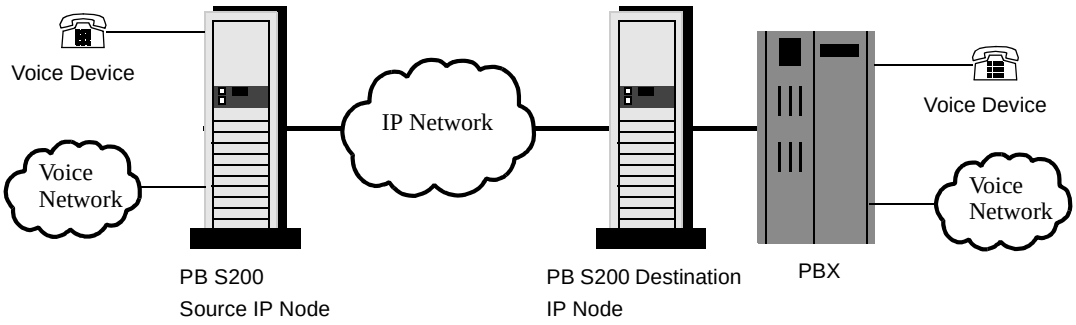

Figure 2. Example Network Topology

Node Conventions

The node conventions described below refer to Figure 2 and are used throughout this document.

Convention	*Description*
Voice Device or Network	The voice device or network sends voice to the voice port on the source IP node.
Source IP Node	The source IP node is a PathBuilder S200 series switch that • connects directly to the voice device. • connects directly to the IP network. • connect directly to a frame relay network supporting voice. • encapsulates voice received from the voice device or network using 3Com's SoTCP protocol. • initiates calls to the peer, the destination IP node.
Destination IP Node	The destination IP node is a PathBuilder S200 series switch that receives SoTCP packets sent from the source IP node over the IP network. The destination IP node un-encapsulates SoTCP packets and sends voice traffic to the PBX.The PBX may also connect to a frame relay network supporting voice.
PBX	The PBX connects to the destination IP node and receives voice traffic from it.

SoTCP Operation

Introduction

This section describes the operation of SoTCP protocol. SoTCP provides the encapsulation method for carrying voice traffic over an IP network.

SoTCP Packet Format

The SoTCP protocol terminates voice traffic received from a voice device and prefixes the traffic with a 3-byte SoTCP header or 4-byte SoTCP header, depending on the version of SoTCP protocol. Figure 3 illustrates the SoTCP packet.

Figure 3. SoTCP Packet Format

The SoTCP header contains information that will allow a destination IP node to reconstruct the voice packet at the remote end.

Transport Mechanism

To carry voice traffic over IP, SoTCP uses two Transport layer protocols, the Transport Control Protocol (TCP) and User Datagram Protocol (UDP).

Transport Layer Protocol	*Traffic Carried*	*Description*
TCP	Voice Signalling Traffic	SoTCP uses TCP to carry voice signalling traffic because TCP provides reliable, sequenced packet delivery. Voice signalling traffic encapsulated by SoTCP must arrive at the destination node without error or delay. TCP implements error recovery for duplicate or lost packets.
UDP	Audio and Fax	SoTCP transports audio and fax traffic over UDP session. Unlike TCP, UDP provides fast and simple transaction services with minimal protocol overhead. UDP provides a best-effort, transport mechanism only and does not ensure reliable delivery.

Each TCP or UDP session may carry multiple switched virtual circuits (SVCs). SoTCP uses SVC call setup and routing procedures to establish voice SVCs.

Establishing a Call

Introduction

This section describes call establishments. Figure 4 shows the packets exchanged for session and connection establishment and finally, voice transfer.

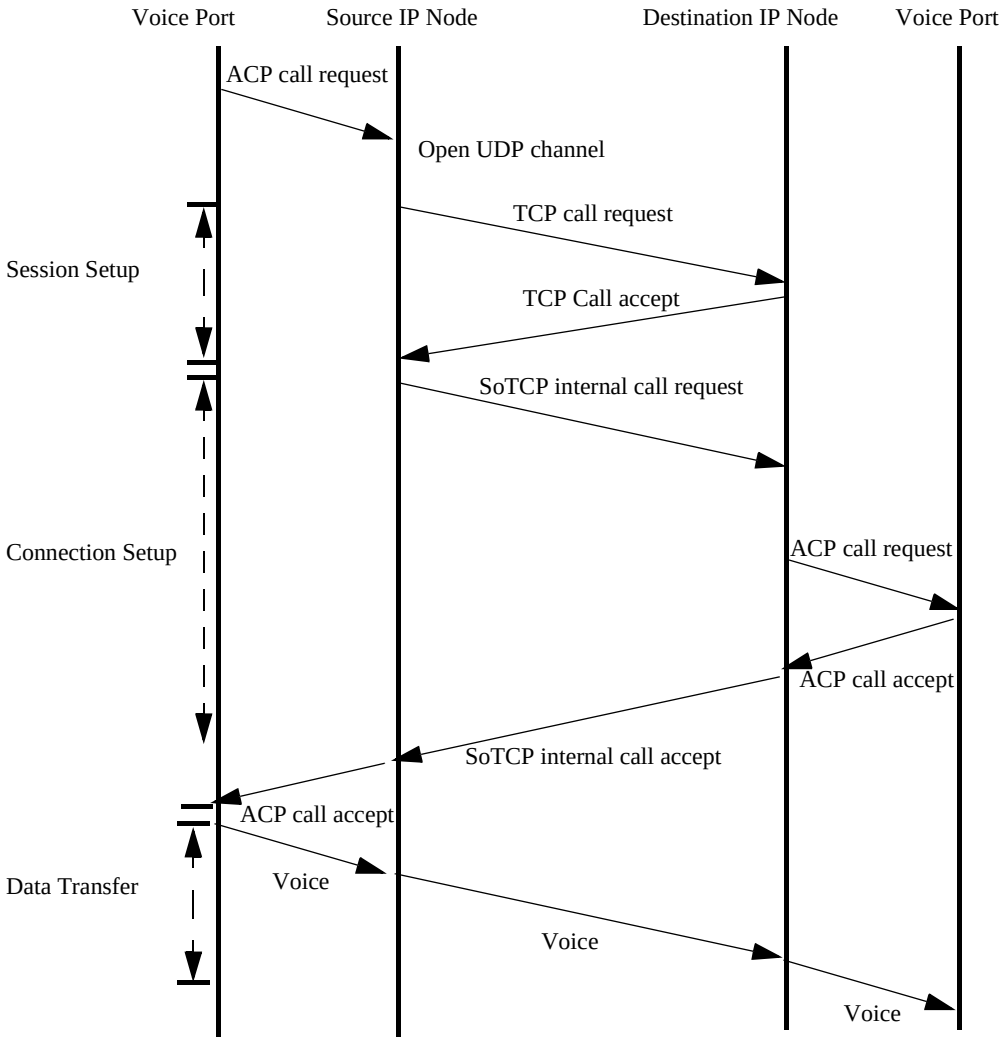

Figure 4. Session and Connection Establishment

Establishing a Session

Before voice traffic can pass between the voice ports over the network, the source IP must establish a TCP and UDP session with the destination IP node. Each session is uniquely identified by a source IP address, destination IP address, source port number, and destination port number. The source and destination node exchange the following call packets to establish a session:

Stage	Packet Transferred	Description
1	ACP Call Request	The voice port sends an ACP (Adjacent Channel Protocol) Call Request to inform the source IP node that it wishes to send voice over the network to the destination voice port.
	Open UDP	When a voice port attempts to make a call, the Source IP node opens a UDP channel.
2	TCP Call Request	To open a session, the source IP node sends a TCP call request to the destination IP node.
	TCP Call Accept	The destination IP node responds to the Call Request by sending a Call Accept, and establishes a TCP session.

Establishing a Connection

After opening a TCP and UDP session, the source node must establish an SoTCP connection with the destination IP node. Each TCP session support multiple connections or SVCs. A unique connection identifier identifies each connection multiplexed on a TCP session. The source and destination IP nodes exchange the following call packets to establish a connection:

Stage	Packet Transferred	Description
1	SoTCP Internal Call Request	The source IP node sends an internal SoTCP call request packet with the UDP port number included, to the destination IP node. The destination IP node examines the facilities field in the header to determine the presence of voice traffic. If voice traffic is present, the destination IP node opens a UDP channel. The destination IP node uses the UDP port number in the internal SoTCP call request packet to identify the destination port for UDP packets.
2	ACP Call Request	The destination IP node sends an ACP call request to the remote voice port.
	ACP Call Accept	To accept the call, the voice port responds with an ACP Call accept packet.

Stage	Packet Transferred	Description (continued)
3	SoTCP Internal Call Accept	Once the destination IP node receives the ACP call accept from the remote voice port, it sends a SoTCP Internal Call Accept to the source IP node. The remote port's UDP port number is included in this packet to inform the other end of its UDP port number. The connection between the nodes is now established.
4	ACP Call Accept	The source IP node sends an ACP Call Accept to the voice port and the port may begin to send voice packets to the destination.

Data Transfer

The SoTCP protocol attaches the 3 or 4-byte header to the packet. The SoTCP protocol then sends voice packets over the UDP channel.

VoIP Applications

Introduction

This section describes typical applications of VoIP and the benefits of implementing voice over an IP network.

Applications

VoIP can be used to provide cost effective, long distance phone services over the IP network. Figure 5 illustrates a network using VoIP to support fax and voice calls between two branch offices in different locations.

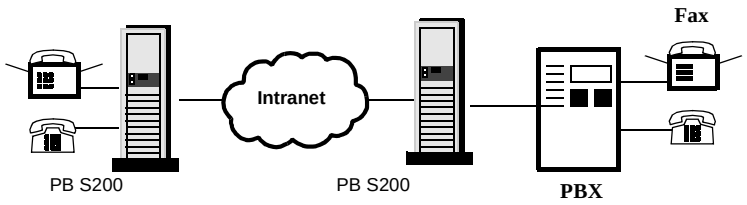

Figure 5. VoIP Applications for Small Branch Offices

In Figure 6, the PathBuilder S24x, 26x, and 27x switches act as gateways to route calls over the IP network. With this implementation, the caller only needs to call a local number to start a long distance conversation.

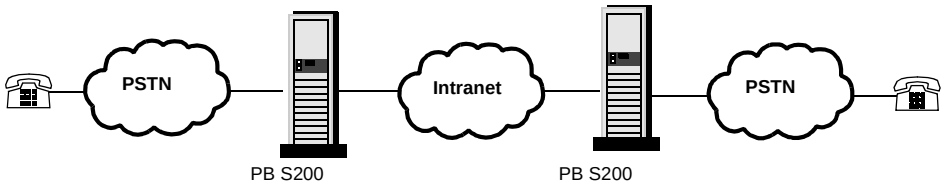

Figure 6. VoIP Applications for Long Distance Telephone Service

Figure 7 illustrates a network supporting voice within an Intranet and voice over a public or private frame relay network using 3Com's Voice Relay.

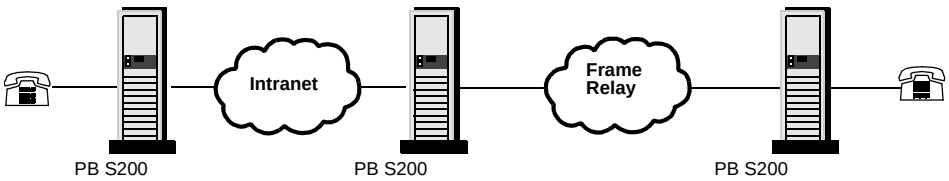

Figure 7. VoIP Applications and Voice Relay Support

Example VoIP Configuration

Introduction

This section shows an example of how to configure VoIP. Figure 8 illustrates how two PathBuilder S24x, 26x, and 27x switches can support long distance telephone service between a small branch office and a head office, over the company's Intranet.

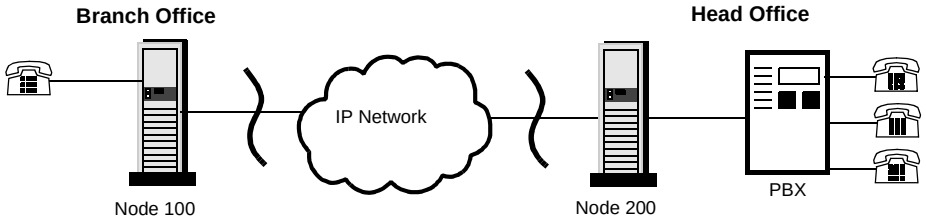

Figure 8. VoIP Configuration Example

Node 100 and Node 200 are configured with FXS Voice ports. The branch office phone can be configured as an extension phone number off the head office's PBX. The nodes connect to the Ethernet LAN and therefore an Ethernet port must be configured for each node. The associated IP interface parameters must also be configured. To carry voice traffic over the IP network, the SoTCP parameters must be configured.

Recommended Sequence for Configuration

The following table describes the recommended sequence to configure a PathBuilder S200 series switch for VoIP. Refer to Figure 9 for the list of configurable parameters.

Step	Description
1	Configure the Node Record.
2	Configure the Voice Port and Voice Switching Table.
3	LAN and IP Parameters: • Configure the LAN Port • Enable the PathBuilder S200 series switch Interface State • Configure IP Parameters • Configure IP Interfaces • Configure the Route Selection Table
4	VoIP Parameters: • Configure the SOTCP Record • Configure the SOTCP Map Table

■ Note

This example assumes default settings for parameters not otherwise specified in the tables. For more information on configuring the voice port refer to the *Voice Relay Option Guide*.

Configuration

Figure 9 shows the parameters configured for each PathBuilder S200 series switch.

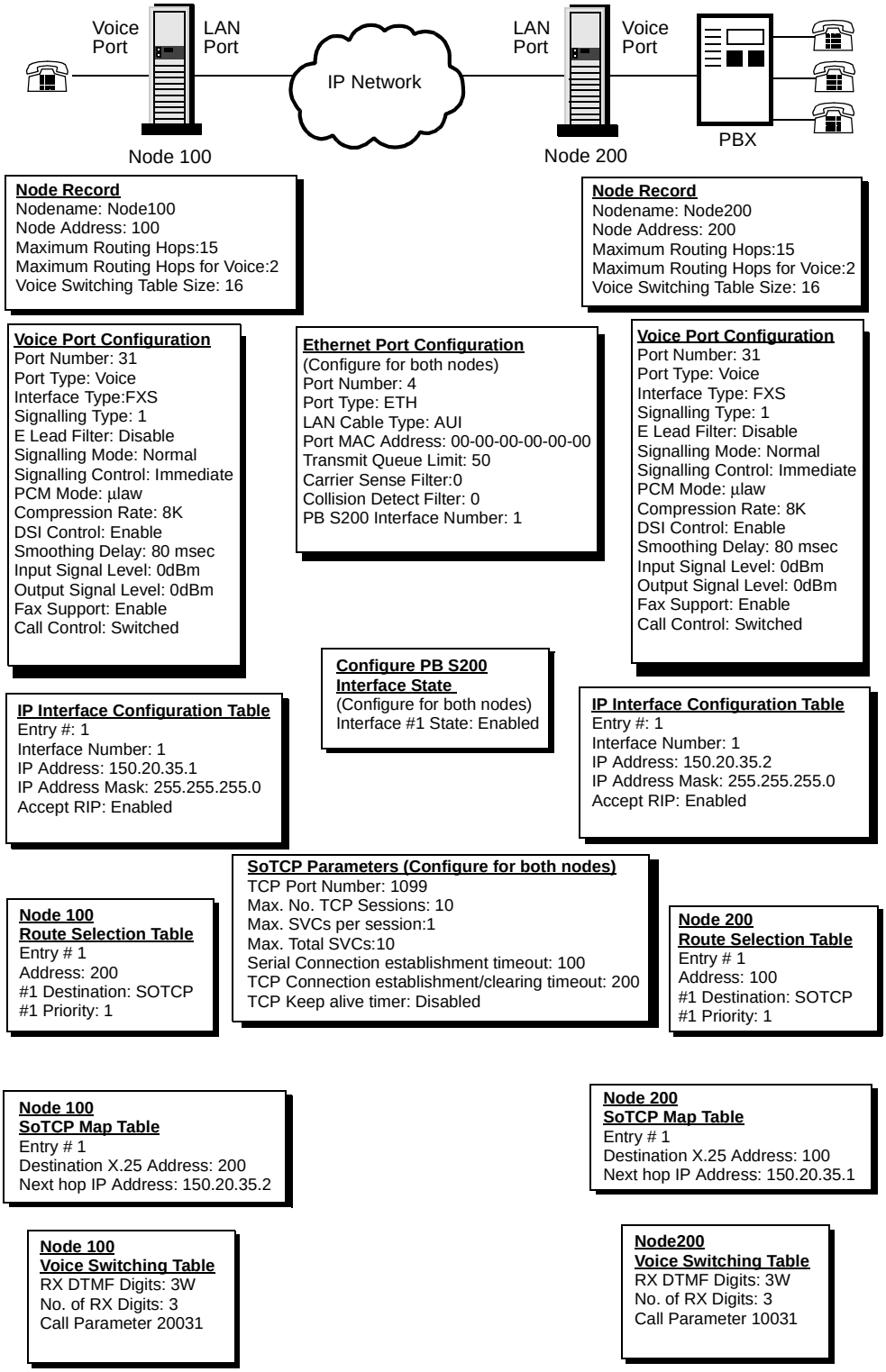

Figure 9. Configurable Parameters to support VoIP

Configuring VoIP

Introduction

These sections describe how to configure the VoIP option. The parameters for the VoIP option are specified in three records:

- “SoTCP Parameters” on page 12.
- “Route Selection Table Parameters” on page 15.
- “SoTCP Map Table Parameters” on page 16.

SoTCP Parameters

Navigating the CTP

Figure 10 shows the CTP path to the SoTCP specific parameters.

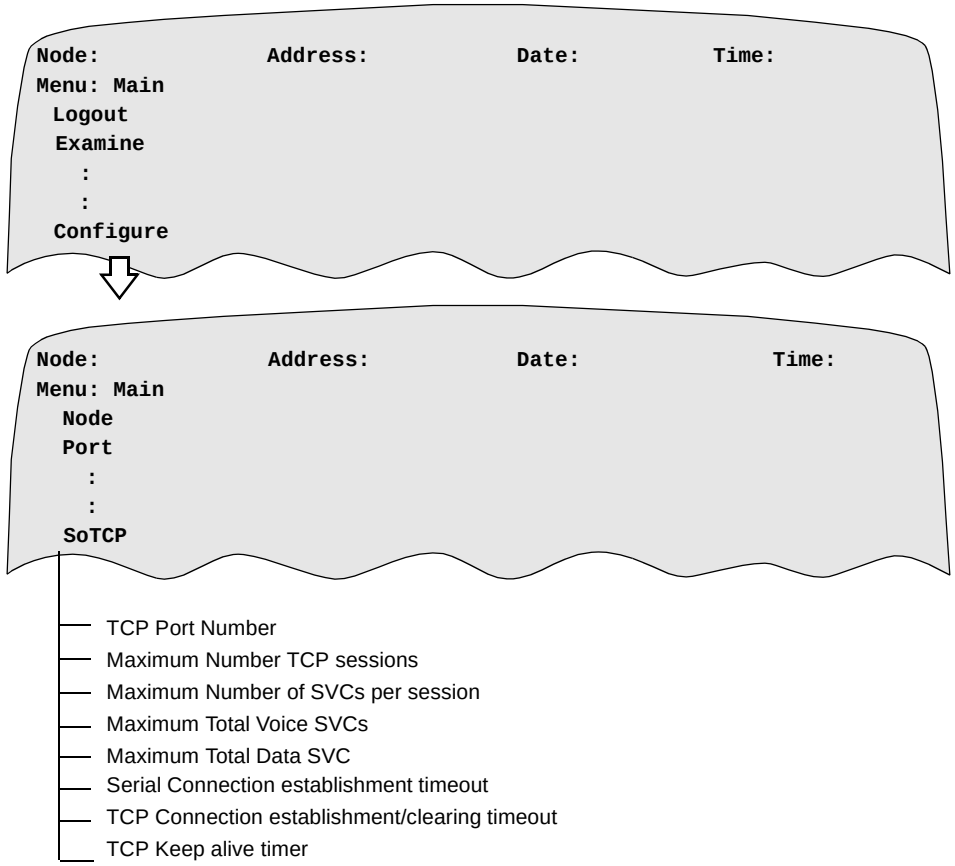

Figure 10. SoTCP Parameters

SoTCP Parameter Descriptions

The SoTCP parameter record contain these parameters:

TCP Port Number

Range	256 to 65535
Default	1099
Description	Specifies the TCP port number at which SoTCP listens for new connections. The remote-end must have the same value configured for this feature to function.
Boot Type	SoTCP Boot

Maximum Number of TCP Sessions

Range	1 to 40
Default	1
Description	Specifies the maximum number of TCP sessions allowed through SoTCP. Once the maximum number is reached, no more sessions will be established and the “SoTCP-No more TCP sessions” alarm will be generated.
Boot Type	SoTCP Boot

Maximum Number SVCs per Session

Range	1 to 50
Default	10
Description	Specifies the maximum number of switched virtual circuits (SVCs) that may be multiplexed on a TCP session through SoTCP. Once the maximum number is reached, no more connections will be established and the “SoTCP-n-No more connections to SoTCP” alarm will be generated.
Boot Type	Node Boot

Maximum Total Voice SVCs

Range	0 to 30
Default	0
Description	Specifies the maximum total number of voice SVCs allowed.
Boot Type	Node Boot

Maximum Data SVCs

Range	1 to 1024
Default	10
Description	Specifies the maximum number of data SVCs that may be multiplexed on all TCP connections.
Boot Type	Node

Serial Connection Establishment Timeout

Range	1 to 200. Specified in 50 ms increments.
Default	100
Description	Specifies the time SoTCP waits for connection establishment with the serial device. When a node receives a call request from a source node, the SoTCP will send a Call Request packet to the serial protocol and waits for a Call Accept packet. If the SoTCP protocol does not receive a Call Accept packet within the timeout, it sends a Call Clear packet to the source node.
Boot Type	SoTCP Boot

TCP Connection Establishment or Clearing Timeout

Range	1 to 200. Specified in 50 ms increments.
Default	100
Description	Specifies the time SoTCP waits for the connection establishment or connection clearing with the peer SoTCP protocol.
Boot Type	SoTCP Boot

TCP Keep Alive Timer

Range	Enabled, Disabled
Default	Enabled
Description	Used to enable or disable the TCP Keep Alive Timer. • Enabled: TCP protocol sends keep alive packets over the network at a one minute interval. If the destination node does not respond to the keep alive packets, source node clears TCP sessions. • Disabled: TCP protocol does not send keep alive packets over the network.
Boot Type	SoTCP Boot

Route Selection Table Parameters

Parameters

These Route Selection Table parameters should be configured:

Note

A table boot is required for changes to these parameters to take affect.

Entry Number

Range	1 to 16
Default	1
Description	Specifies the number used to reference this table record.

Address

Range	0 to 15 digits
Default	blank
Description	Specifies the network address for calls routed beyond this node.

Destination #1

Range	0 to 32 alphanumeric characters. Use space to blank the field.
Default	blank
Description	Specifies the destination to which calls are routed. Enter SoTCP.

SoTCP Map Table Parameters

Navigating the CTP Figure 11 shows the CTP path to the SoTCP map parameters.

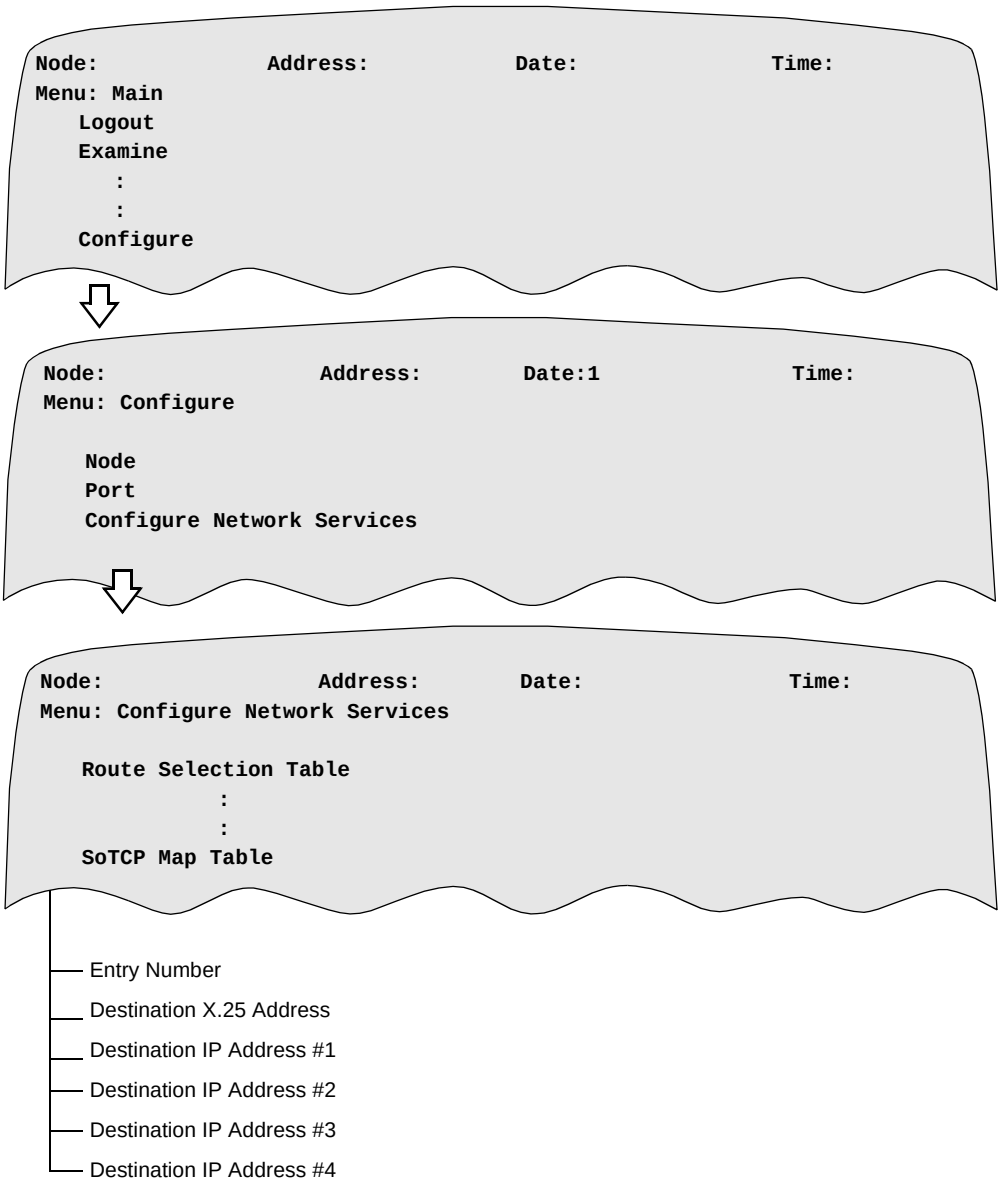

Figure 11. SoTCP Map Table Parameters

Parameters

These SoTCP map table parameters should be configured:

Note

A node boot is required for changes to these parameters to take affect.

Entry Number

Range	1 to 32 for PathBuilder S21x switch 1 to 64 for PathBuilder S24x, 26x, and 27x switch
Default	1
Description	Specifies the number used to reference this table record.

Destination Address

Range	0 to 15 digits.
Default	blank
Description	Specifies the network address for calls for which TCP sessions must be established. Use space to blank the field.

Destination IP Address

Range	X.X.X.X. (Where X is between 0 and 255.)
Default	0.0.0.0
Description	Specifies the unicast IP address of the node to which calls are routed. Calls with a network address corresponding to this entry will establish a TCP session with this destination. **Note** You may configure up to four destination IP addresses for each destination X.25 address. This allows a user to specify alternate destination IP addresses to connect to the same destination X.25 address.

Statistics

Introduction

This section describes the statistics available for the SoTCP option.

Types of Statistics

You can generate these statistics:

- SoTCP statistics
- Detailed SoTCP statistics

Navigating the CTP

Figure 12 shows the CTP path to the SoTCP statistics.

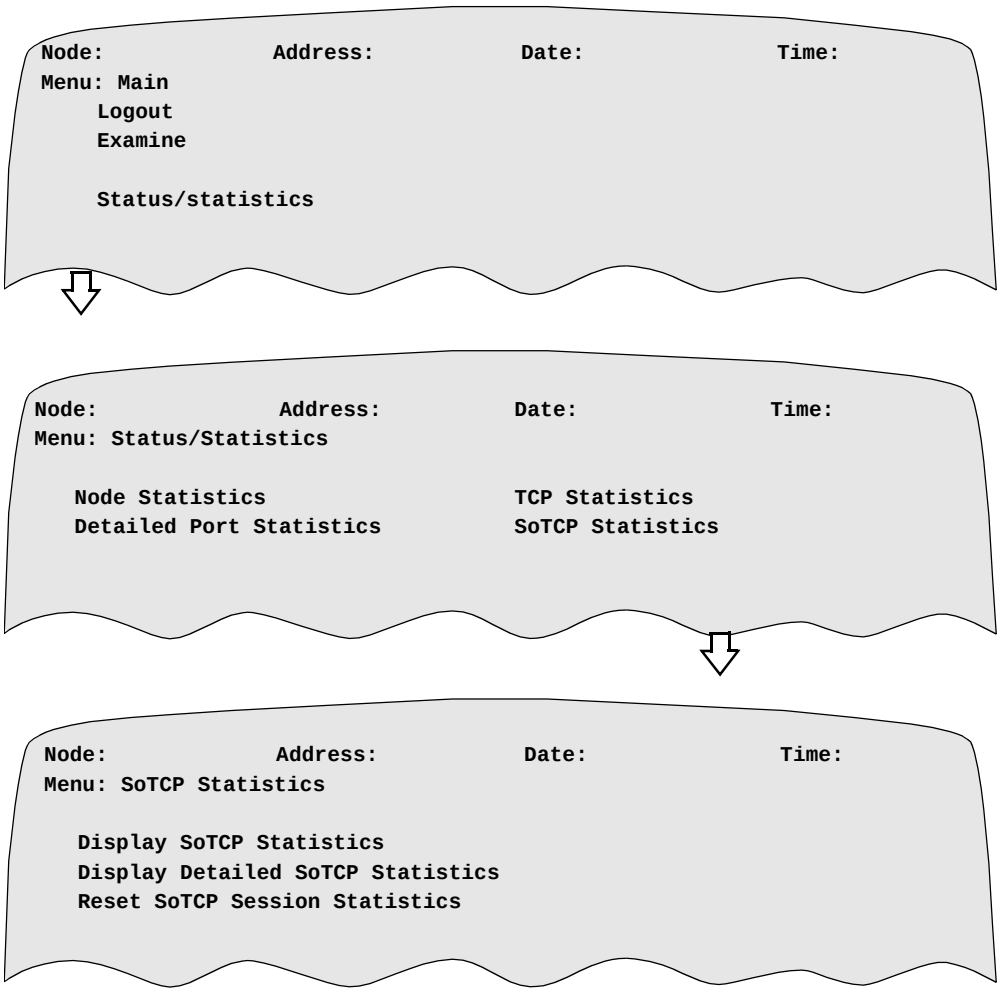

Figure 12. Statistics Screen

SoTCP Statistics

Example

Figure 13 shows the SoTCP statistics screen.

```
Node:           Address:              Date:                Time:
SoTCP Statistics                                           Page 1 of 1



Transaction Summary:
                                IN          OUT
TCP Packets                1234567890    1234567890
Serial Packets             1234567890    1234567890


Slot Summary:

Number of TCP sessions         123
Number of Serial SVCs          123

Number of Voice SVCs           123
Total Number of SVCs           123



Press any key to continue (ESC to exit)...
```

Figure 13. SoTCP Statistics

Description

This table describes the screen attributes shown in Figure 13.

Item	*Description*
TCP packets IN	Total number of packets received by SoTCP from TCP.
TCP packets OUT	Total number of packets transmitted by SoTCP to TCP.
Packets IN	Total number of packets received by SoTCP from the serial protocol.
Packets OUT	Total number of packets transmitted by SoTCP to the serial protocol.
Number of TCP session	Total number of active TCP sessions.
Number of serial SVCs	Specifies the number of serial data SVCs on all TCP sessions.
Number of voice SVCs	Specifies the number of voice SVCs on all TCP sessions.
Total number of SVCs	Total number of serial and voice SVCs.

SoTCP Detailed Statistics

Example

Figure 14 shows the detailed SoTCP statistics screen.

```
Node: NODENAME  Address: blank         Date:                 Time:
SoTCP Detailed Statistics              Page 1 of 1


TCP session                      : 1 of 1

SoTCP Version                    : 1
Number of SVCs                   : Current 12
Status                           : Wait Data
UDP Port Number                  : Local                     Remote
Transaction Summary:

                                 IN                          OUT

Characters:
Serial Packets:
Out of Sequence Packets Discard:

Conn-ID Chars IN   Chars OUT  Pkts IN    Pkts Out    Status    Type Uptime


Press any key to continue (ESC to exit)...
```

Figure 14. SoTCP Detailed Statistics

Description

This table describes the screen attributes shown in Figure 14.

Item	*Description*
TCP session	Specifies the TCP session.
Destination IP address	Specifies the IP address of the destination node.
SoTCP version	Specifies the version of SoTCP running on this session.
Number of SVCs (current)	Specifies the total number of SVCs which are transported through this TCP session.
Number of SVCs (maximum)	Specifies the maximum number of SVCs which are transported through this TCP session.

Item	Description (continued)
Status	Specifies the current state of the session. Status messages include: • Start • Idle • Wait Hdr • Wait Data • Abort The values mentioned apply to connection status.
UDP Port Number	Specifies the local port number when a voice SVC is present.
Out of sequence packets discarded	Specifies the number of packets received on the UDP port with an invalid sequence number. Packets with a invalid sequence number are discarded.
Connection ID	Connection identifier of the multiplexed SVC.
Type	Specifies the type of traffic, data or voice.
Uptime	Time elapsed since call establishment.

Appendix A
Technical Support

3Com provides easy access to technical support information through a variety of services. This appendix describes these services.

Information contained in this appendix is correct at time of publication. For the very latest, 3Com recommends that you access the 3Com Corporation World Wide Web site.

Online Technical Services

3Com offers worldwide product support 24 hours a day, 7 days a week, through the following online systems:

- World Wide Web site
- 3Com FTP site
- 3Com Bulletin Board Service (3Com BBS)
- 3ComFacts℠ automated fax service

World Wide Web Site

Access the latest networking information on the 3Com Corporation World Wide Web site by entering the URL into your Internet browser:

http://www.3com.com/

This service provides access to online support information such as technical documentation and software library, as well as support options ranging from technical education to maintenance and professional services.

3Com FTP Site

Download drivers, patches, and software, across the Internet from the 3Com public FTP site. This service is available 24 hours a day, 7 days a week.

To connect to the 3Com FTP site, enter the following information into your FTP client:

- Hostname: **ftp.3com.com (or 192.156.136.12)**
- Username: **anonymous**
- Password: **<your Internet e-mail address>**

Note

A user name and password are not needed with Web browser software such as Netscape Navigator and Internet Explorer.

3Com Bulletin Board Service

The 3Com BBS contains patches, software, and drivers for 3Com products. This service is available through analog modem or digital modem (ISDN) 24 hours a day, 7 days a week.

Access by Analog Modem

To reach the service by modem, set your modem to 8 data bits, no parity, and 1 stop bit. Call the telephone number nearest you:

Country	*Data Rate*	*Telephone Number*
Australia	Up to 14,400 bps	61 2 9955 2073
Brazil	Up to 14,400 bps	55 11 5181 9666
France	Up to 14,400 bps	33 1 6986 6954
Germany	Up to 28,800 bps	4989 62732 188
Hong Kong	Up to 14,400 bps	852 2537 5601
Italy	Up to 14,400 bps	39 2 27300680
Japan	Up to 14,400 bps	81 3 3345 7266
Mexico	Up to 28,800 bps	52 5 520 7835
P.R. of China	Up to 14,400 bps	86 10 684 92351
Taiwan, R.O.C.	Up to 14,400 bps	886 2 377 5840
U.K.	Up to 28,800 bps	44 1442 438278
U.S.A.	Up to 28,800 bps	1 408 980 8204

Access by Digital Modem

ISDN users can dial in to the 3Com BBS using a digital modem for fast access up to 56 Kbps. To access the 3Com BBS using ISDN, use the following number:

1 408 654 2703

3ComFacts Automated Fax Service

The 3ComFacts automated fax service provides technical articles, diagrams, and troubleshooting instructions on 3Com products 24 hours a day, 7 days a week.

Call 3ComFacts using your Touch-Tone telephone:

1 408 727 7021

Support from Your Network Supplier

If additional assistance is required, contact your network supplier. Many suppliers are authorized 3Com service partners who are qualified to provide a variety of services, including network planning, installation, hardware maintenance, application training, and support services.

When you contact your network supplier for assistance, have the following information ready:

- Product model name, part number, and serial number
- A list of system hardware and software, including revision levels
- Diagnostic error messages
- Details about recent configuration changes, if applicable

If you are unable to contact your network supplier, see the following section on how to contact 3Com.

Support from 3Com

If you are unable to obtain assistance from the 3Com online technical resources or from your network supplier, 3Com offers technical telephone support services. To find out more about your support options, please call the 3Com technical telephone support phone number at the location nearest you.

When you contact 3Com for assistance, have the following information ready:

- Product model name, part number, and serial number
- A list of system hardware and software, including revision levels
- Diagnostic error messages
- Details about recent configuration changes, if applicable

Below is a list of worldwide technical telephone support numbers:

Country	*Telephone Number*	*Country*	*Telephone Number*
Asia Pacific Rim			
Australia	1 800 678 515	P.R. of China	10800 61 00137 or
Hong Kong	800 933 486		021 6350 1590
India	61 2 9937 5085	Singapore	800 6161 463
Indonesia	001 800 61 009	S. Korea	
Japan	0031 61 6439	From anywhere in S. Korea:	82 2 3455 6455
Malaysia	1800 801 777	From Seoul:	00798 611 2230
New Zealand	0800 446 398	Taiwan, R.O.C.	0080 611 261
Pakistan	61 2 9937 5085	Thailand	001 800 611 2000
Philippines	1235 61 266 2602		
Europe			
From anywhere in Europe, call:	+31 (0)30 6029900 phone +31 (0)30 6029999 fax		
From the following European countries, you may use the toll-free numbers:			
Austria	06 607468	Netherlands	0800 0227788
Belgium	0800 71429	Norway	800 11376
Denmark	800 17309	Poland	0800 3111206
Finland	0800 113153	Portugal	05 05313416
France	0800 917959	South Africa	0800 995014
Germany	0130 821502	Spain	900 983125
Hungary	00800 12813	Sweden	020 795482
Ireland	1 800 553117	Switzerland	0800 55 3072
Israel	177 3103794	U.K.	0800 966197
Italy	1678 79489		
Latin America			
Argentina	541 312 3266	Colombia	571 629 4847
Brazil	55 11 523 2725, ext. 422	Mexico	01 800 849 2273
North America	1 800 NET 3Com (1 800 638 3266)		

Returning Products for Repair

Before you send a product directly to 3Com for repair, you must first obtain a Return Materials Authorization (RMA) number. Products sent to 3Com without RMA numbers will be returned to the sender unopened, at the sender's expense.

To obtain an RMA number, call or fax:

Country	*Telephone Number*	*Fax Number*
Asia, Pacific Rim	65 543 6342	65 543 6348
Europe, South Africa, and Middle East	011 44 1442 435860	011 44 1442 435718
From the following European countries, you may call the toll-free numbers; select option 2 and then option 2:		
Austria	06 607468	
Belgium	0800 71429	
Denmark	800 17309	
Finland	0800 113153	
France	0800 917959	
Germany	0130 821502	
Hungary	00800 12813	
Ireland	1800553117	
Israel	177 3103794	
Italy	1678 79489	
Netherlands	0800 0227788	
Norway	800 11376	
Poland	00800 3111206	
Portugal	05 05313416	
South Africa	0800 995014	
Spain	900 983125	
Sweden	020 795482	
Switzerland	0800 55 3072	
U.K.	0800 966197	
Latin America	1 408 326 2927	1 408 764 6883
U.S.A. and Canada	1 800 876 3266, option 2	1 408 764 7120

3/26/98

Index

Numerics

3Com bulletin board service (3Com BBS) A-2
3Com URL A-1
3ComFacts A-2

A

applications 2, 8

B

bulletin board service A-2

C

call establishment 5
configuration
  example 9
  parameters 11
  sequence 9
  voice port 9

D

data transfer 7
destination IP node 3

E

encapsulation mechanism 2

F

fax service (3ComFacts) A-2

N

network supplier support A-2
network topology
  example 3
  node conventions 3
node conventions 3

O

online technical services A-1

R

returning products for repair A-4

S

Serial Protocol over TCP, see SoTCP
session establishment 6
SoTCP
  encapsulation mechanism 2
  operation 4
  packet format 4
  parameters 12
source IP node 3
statistics 18
SVC 4
  maximum number of 13
SVCs
  maximum number of voice 13
Switched Virtual Circuits, see SVCs

T

TCP 4
  port number 12
  sessions, maximum number of 13
technical support
  3Com URL A-1
  bulletin board service A-2
  fax service A-2
  network suppliers A-2
  product repair A-4
timeout
  serial connection establishment 14
  TCP connection establishment 14
Transport Control Protocol, see TCP

U

UDP 4
URL A-1
User Datagram Protocol, see UDP

V

voice
  audio and fax 4
  signalling traffic 4
voice device 3
VoIP
  key features 2

W

World Wide Web (WWW) A-1